FOCUS DISCUSSION GROUP G

The Role of an Oil / Gas Metering Auditor in Common Carriage Pipelines.

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THE ROLE OF AN OIL/GAS METERING AUDITOR IN COMMON CARRIAGE PIPELINES

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SUMMARY

The objective of this paper is to cause discussion within the oil and gas industry concerning the need, role, responsibility and authority of a metering auditor/inspector within common carriage pipeline systems. The paper will examine the areas of Tick Box Audits, categorisation of non-compliant items, audit reporting, Auditors Independence, role responsibility, what happens when the audit is over and the report published, and the future and way ahead for measurement auditing.

1.0 INTRODUCTION

Annually, it is estimated that collectively in excess of £1 M is spent by UK pipeline operators and installation operators on measurement system auditing. Very often the auditor is appointed as an independent auditor from one of several specialist metering companies to carry out this service.

Whilst operators may believe that their audit criteria are necessarily specific to their pipeline, invariably we all play by the same technical rules eg ISO 5167, IP, DTI requirements etc. and most contractual conditions are similar. Therefore, there is a clear use for a common set of audit criteria for UK Continental Shelf operations and a standard reporting format.

Operators may be surprised to know that around 50-70% of auditing costs are spent in preparing the reports to the format required by a individual operator. In line with CRINE initiatives, this paper will focus on areas where commonality in auditing will result in more focused auditing activities, more concise and informative reports and give the industry cost reduction benefits.

2.0 TICKBOX AUDITS

Tick box audits is the term used here to describe the type of audit where the auditor is required to complete an audit report which has been preformatted by the pipeline operator. The auditor is then required to TICK or CROSS an item of the criteria either compliant or non-compliant as appropriate and to reference any comments that do not meet the criteria.

Key to any audit is a set of agreed audit criteria. In general the criteria used by most pipelines were developed and agreed some years ago. Many are in need of updating to reflect the way in which metering systems are actually operated and maintained. Some pipelines unfortunately, still need a set of criteria developed.

2.1 Many of the pipeline operators combine the audit criteria with the audit report. This means that the audit report can be some 50 pages long before any comments have been made. Are the people who read these reports at pipeline committee meetings really interested in the list of test equipment used, or do they need to have copies of the densitometer calibration certificates at a particular installation, especially when the auditor has already ticked a box to note the validity of all test equipment, certification etc.

2.2 Comments against a particular audit item must usually be made on the same page concerning the equipment to be inspected. Comments must then be carried forward to the front of the document together with their reference into a so called summary. All to often the summary can end up excessively long if the recommendations are also to be included in the summary. Would not a true summary simply state whether a metering system is, or is not fit for purpose ?

2.3 All to often, issues have to be reported in more than one section of the report.

As an example if a Relative Density (RD) analyser has been identified as having the wrong value of pure methane stated on the test gas certificate and used for its calibration, this has to be reported as follows:-

i) Comment in the RD analyser section of the report,

ii) The same comment in the Flow Computer section of the report, as this is also part of flow computer configuration,

ii) The same comment in the section for Certification,

iv) The same comment in the section for Calibration.

Therefore in the previous example, the same statement must be repeated at least 4 times to fully satisfy the operators reporting format.

2.4 Clearance of actions from previous audits are often required to be stated together with any actions taken by the installation operator. The auditor is often faced with a challenge on how to differentiate between comments form a previous audit that are still relevant and comments that are new or related to the previously reported item

All of the above can make a typical audit report some 60-80 pages in length. The question must be asked; is any one who reads these reports interested in what is compliant ? Surely the reader is only interested in what is non-compliant.

2.5 One way forward, would be for the audit report to take the form of an Exception Report only. Where an exception to the audit criteria has been found the auditor could reference the point to the operators criteria, but need only mention the exception once. The report length could be reduced to around 3 to 5 pages in length instead of > 50. Here there must be obvious advantages to both auditor, reader, platform and pipeline operator in terms of the quantity of data to be read, document storage, time spent writing and hence quicker delivery of audit report, (a continual issue between auditors and their clients).

There is also one further advantage in this reporting format. The reports are often not only used to report to the pipeline operator and all other pipeline participants, but are also used for reporting to field partners. There must be great advantage to field operator and field partner alike if a short form report is submitted where, only the clear issues are identified.

This process could be taken one step further. Currently, once all the pipeline metering station audits have been completed and the reports issued, a meeting of all pipeline participants is normally held and the findings of the relevant reports discussed. From these audit reports, an action or task list is made for each operator to action to ensure/maintain their system compliance. At this stage, there is therefore, an opportunity to cut out some of the paper work and for the auditor to issue his findings as an Issues and Action plan. An example of this is attached in Attachment 1.

Reporting only non-compliant items will save everyone time and effort.

3 CATEGORISATION OF NON-COMPLIANCE'S

The auditor is required to categorise all non-compliance's to a format agreed by all pipeline participants. There is great variation amongst all the various audit criteria with regard to this classification. It is believed that some of the categories used, were developed many years ago and were developed for political reasons rather than technical.

Two examples of the variation in non-compliance categories are shown below:-

Example 1

Category 1	:	A fundamental fault or deficiency which, in the auditor's opinion, causes a **major** (> 1%) measurement error.
Category 2	:	A fault or deficiency which, in the auditor's opinion, causes a **minor** (< 1%) measurement error.
Category 3	:	A deficiency in procedures, log books, etc. which has no effect on measurement integrity.
Category 4	:	Where some aspect of the metering station is less than satisfactory, but not in a way such that it would fall into categories 1 to 3. Such a deficiency could be rectified with little effort.

Example 2

Category 1	:	A fundamental fault identified during the audit visit.
Category 2	:	A fundamental fault which had occurred since the last audit but had been rectified before this audit.
Category 3	:	A minor problem with procedure's, log book's etc. which have no affect on measurement accuracy.

In *Example 1* above, the problems with this method of categorisation is that the 1% rule for significance will treat larger pipeline users differently to that of a small one. IE if 'Platform A' contributes 60% of a pipeline throughput and 'Platform B' contributes 10% of the same pipeline throughput, 'Operator A' can have much greater effect on the pipeline balance without penalty.

In *Example 2* above, when an operator is given a Category 1 finding, it simply means that this is a new finding, not a measure of its seriousness. Due to this, the auditor often receives phone calls and letters form the operator simply as a function of the issue being called Category 1 and often does not appreciate the actual categorisation the auditor is obliged to use for that particular pipeline.

A common set of categories for the classification of non-compliant items based on financial or allocation sensitivity/risk would help all concerned here.

4 WHAT IS THE ROLE OF THE AUDITOR ?

This may appear a straight forward question. However, the role of the auditor differs from pipeline to pipeline. Some pipelines have the auditor carry out the role of simply a witness to calibration activities. This would perhaps be better suited to Technician rather than an Engineer or Consultant. An auditor should be allowed to visit any area which he deems important or significant to maintaining and operating the metering system within the agreed standards. This should include production reporting, mismeasurement reporting, roles and responsibilities of key personnel of the facilities etc.

4.1 One area that is continually overlooked is the calibration of the prover on a liquid system. This is the single most important activity of a liquid system, yet it goes un audited. Why ?

4.2 Other than actually verifying that the auditor was actually attending the audit, what purpose do the following example requirements of the auditor prove:-

i) *"Obtain copies and append to the report of all test equipment certification"*

ii) *"Obtain copies and append to the report all primary and secondary equipment certification".*

Statements like this are not uncommon audit requirements. Given that it is most unlikely that any readers of audit reports will examine equipment certificates and that several kilograms of paper is a nuisance to collate, transport and issue, why is this necessary ?

If you do not trust the auditor to carry out his job, what is he doing there in the first place ?

5.0 THE INDEPENDENCE OF THE AUDITOR

In order for the Auditor to carry out his remit, he should be completely independent of the operator of the facility being inspected. On pipelines where each platform operator is free to select their own auditor for the independent audit, the auditor should be selected on, amongst other criteria, the basis of independence.

5.1 Could the independence of an auditor can be compromised where an auditor or audit company is appointed by the pipeline operator to audit the whole pipeline system and that same company is engaged by a facility operator for other metering work ? The answer to this question has be yes as it must be concluded that complete independence is in doubt.

5.2 Whilst it is not suggested that any auditor is coerced to remove or dilute a comment that puts his company in a bad light, but it must be a difficult to put such a comment in writing in the first place for all to see. An analogy to support this could be:-

> If your car keeps breaking down and you are concerned that the garage would not give an unbiased opinion as to the nature of the fault, would you take the car back to them or go to say the AA for and independent assessment, even though the garage has given an assurance that they would put their best man on the job ?

If it is an 'Independent Audit' that is required, then independence in the auditor should be sought.

6 WAYS AHEAD

The technology used in metering systems has changed over the years, however, the role of the auditor has remained relatively unchanged in that time.

6.1 Many operators these days employ the use of electronic systems to re-transmit all the metering data back to their offices onshore. At their finger tips they have available powerful data gathering, trending, alarming and as a result auditing facilities available. Comparative trending can be used to assess the performance of each piece of metering equipment without having to leave the office. If auditors were given access to this data, this would mean that a great deal of work traditionally carried offshore could be achieved onshore, (usually at less cost). This would leave the auditor free to concentrate on higher level issues whilst at the worksite and not waste time in somewhat trivial issues.

6.2 Log books are still currently hand written documents. If logbooks could be kept by electronic/computers means and made secure to the satisfaction of all concerned, this would further make the role of auditing easier and open for inspection at any time.

If auditors can be given access to the electronic data, the time spent offshore could be focused on more relevant issues.

7 CONCLUSIONS

The conclusions of this paper are:-

i) Audit criteria should be produced that reflect the way in which modern measurement systems are operated and maintained.

ii) Use non-compliance audit reporting to reduce costs to make life easier for all concerned with non-compliance categories that at meaningful and give focus to the issue.

iii) Allow the auditor sufficient free scope in his audit to fully explore areas of concern.

iv) Decide what 'Independence' of your auditor really means.

v) And finally, a plea; Give the auditor adequate time at a facility to carry out his remit. Two days to witness the complete calibration of a three stream gas metering and sampling system including orifice plate inspection is not adequate.

ATTACHMENT 1

EXAMPLE AUDIT REPORT WHERE ONLY NON-COMPLIANCE'S ARE REPORTED

<******> PIPELINE SYSTEM

MEASUREMENT AUDIT REPORT

<Location>

CLIENT REF : <-------->

Prepared by: ______________________________

<AUDITOR>

Revision: **1**

Date: <   >

1.1 EXECUTIVE SUMMARY

It is the opinion of the auditor that the oil/gas metering system at this location is/is not currently being maintained and operated to a satisfactory level and **is/not** fit for purpose.

2.0 NEW ISSUES AND ACTIONS

During this audit <X> new non-compliance's have been identified. Only <X> is considered as significant and is outlined below. All other new comments are of a minor nature.

All new and outstanding non-compliance's are detailed in section 3 of this report.

2.1 One new significant issue has been identified, Issue ref ABC 005.

At this meter station an internal inspection of the meter run revealed large quantities of sand in the meter run. This had built up to a level of around 15 mm in front of the orifice plate. This will be causing an under measurement of production through that particular meter run. Damage to the square edge of the orifice plate will also occur further causing under measurement.

The source of the contamination must be identified and contained. It is the recommendation of the auditor that no further production gas is passed through this meter station until it has been cleaned and the source of the contamination contained.

3.0 Category of Deficiencies

Faults, non-compliant items and omissions identified during an audit are categorised, in this report as follows:

Category 1 A fundamental fault or deficiency which, in the auditor's opinion, causes a **major** (> 500 tonnes) measurement error.

Category 2 A fault or deficiency which, in the auditor's opinion, causes a **minor** (< 500 tonnes) measurement error.

Category 3 A deficiency in procedures, log books, etc. which has no effect on measurement integrity.

Category 4 Where some aspect of the metering station is less than satisfactory, but not in a way such that it would fall into categories 1 to 3. Such a deficiency could be rectified with little effort.

ISSUES/COMMENTS AND ACTION PLAN
<Site>EXPORT METERING
<Date>

Nº	Significi-ance	Issue/Comment	Management Comments/Action Plan	Target Date	Completion Date
1 Jan 96	3	The operator has revised its flow computer alarm limits as identified in point 4 of the Alpha report. All limits are satisfactory with the exception of the flow rate alarms. The low flow alarms have been set at the a value equivalent to the low flow cut-off value of 5%. A more realistic value would be the minimum flow rate that can be achieved through the meter run within the ±1.0% volume uncertainty limit.	Operator to implement comment	2Q96	
2 Jan 96	2	All densitometer pipe work has been replaced since the last inspection. Unfortunately, needle valves have been fitted in the return line to the orifice carrier. These should be full bore ball valves.	Needle valves have been replaced with full bore ball valves.	3Q96	Feb 96
3	1	At this meter station an internal inspection of the meter run 4 revealed large quantities of sand in the meter run. This had built up to a level of around 15 mm in front of the orifice plate. This will be causing an under measurement of production through this particular meter run. Damage to the square edge of the orifice plate has also occurred causing further under measurement. The source of the contamination must be identified and contained. It is the recommendation of the auditor that there is no further export via this meter station until it has been cleaned and the source of the contamination contained.	Operator to evaluate.	4Q96	

Differential Pressure Transfer Standard

The DPS4 Differential Pressure Transfer Standard has been developed in order to improve both productivity and accuracy of offshore calibrations.
The unit allows in-situ calibration, removes the need for atmospheric footprinting and dramatically reduces both manhours and transportation costs.

Peter H Dand, Sales & Marketing Director, Beamex, Leicester, England

The Beamex DPS4 System is a product created through European co-operation. The work carried out to research and develop the concept of the transfer standard was carried out by SIRA with the support of the National Measurement System Policy Unit of the DTI as a project within the flow programme.

The development contract was awarded on the basis that there was a need to improve both the productivity and the accuracy of offshore calibrations for DP (differential pressure) transmitters used for high pressure gas metering. This new calibration concept presents totally new innovative thinking. The DPS4 allows the calibration of differential pressure transmitters with low differential ranges under high static pressure.

Until today, differential pressure transmitters used in offshore environments have been removed from their location to be transported to an onshore based laboratory for calibration. The calibrations have been carried out by using twin post deadweight testers, after which the transmitters have been returned to the platform and installed to their process location.

The DPS4 allows high accuracy calibration of these differential pressure transmitters in-situ and therefore dramatically improves productivity. Also, as the calibration is carried out in the actual environment, errors caused by temperature changes and transportation are eliminated.

The prototype was developed by SIRA using three differential pressure sensor modules to measure differential pressure covering the range of 0 to 1000mbar at static pressures up to 200bar. The readings from each module are software corrected for ideal linearity and compensated for line pressure effects. All three compensated readings are compared by the software in order to identify any problems in the measurement system. In case the differences between the readings are accepted, the average differential pressure is displayed.

The three pressure sensor modules are extensively characterised and tested with optimum performance being achieved at four differential pressures (0, 200, 500 and 1000mbar) at each of five static pressures (0, 50, 100, 150, and 200bar). The sequence of differential pressure is applied three times, rising and falling.

In 1994 an agreement was signed between OY Beamex, Finland and SIRA, England to further develop the product and manufacture to production standards required by the offshore industry. As part of this agreement all of the production units during the first two years of manufacture will be characterised and tested in SIRA's NAMAS accredited laboratory.

The complete Beamex DPS4 System comprises:

Sensor Unit *(Intrinsic Safety Approved to EEx ia IIc T4)*

DPS4 Management Software

Interface Unit

The calibration data of the differential pressure transmitter under test is measured in the Sensor Unit and transmitted via the Interface Unit to the Laptop PC in the Control Room. The Interface Unit is designed to communicate with the DPS4 Sensor Unit and converts the digital signals to standard RS232 signals.

The lead between the Sensor and Interface Units may be up to 1000 metres long. Calibrations are normally carried out with the transmitter under test in-situ, but isolated from the process media. Pressure connection to the DPS4 Senso Unit can either be made by compression, quick release couplings or via a conventional differential pressure transmitter manifold. Nitrogen gas or clean air is used for supply pressure generation.

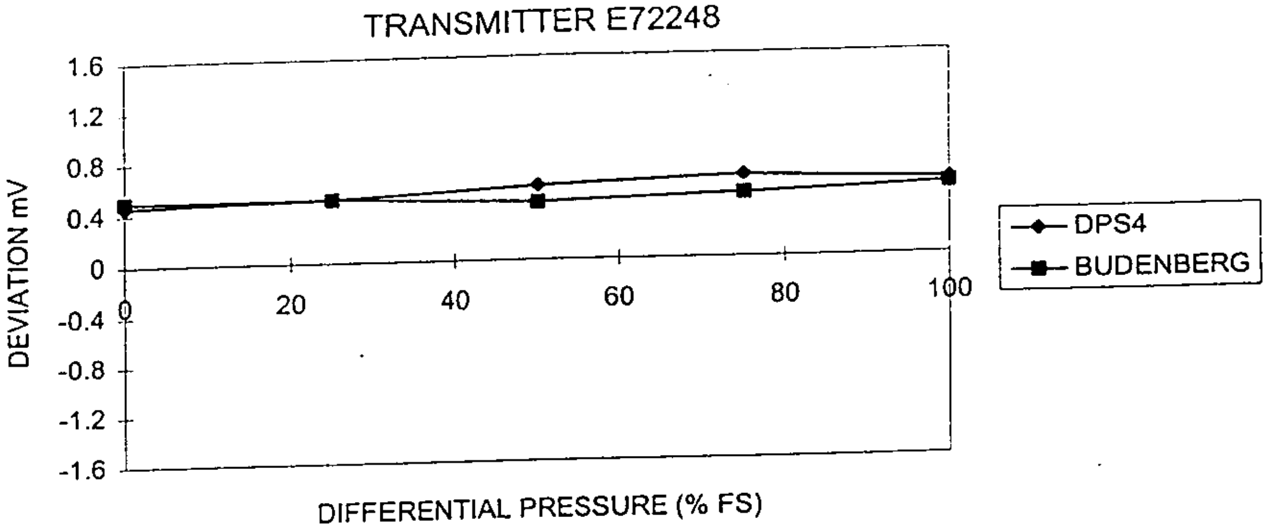
The performance specifications can be summarised as follows:-

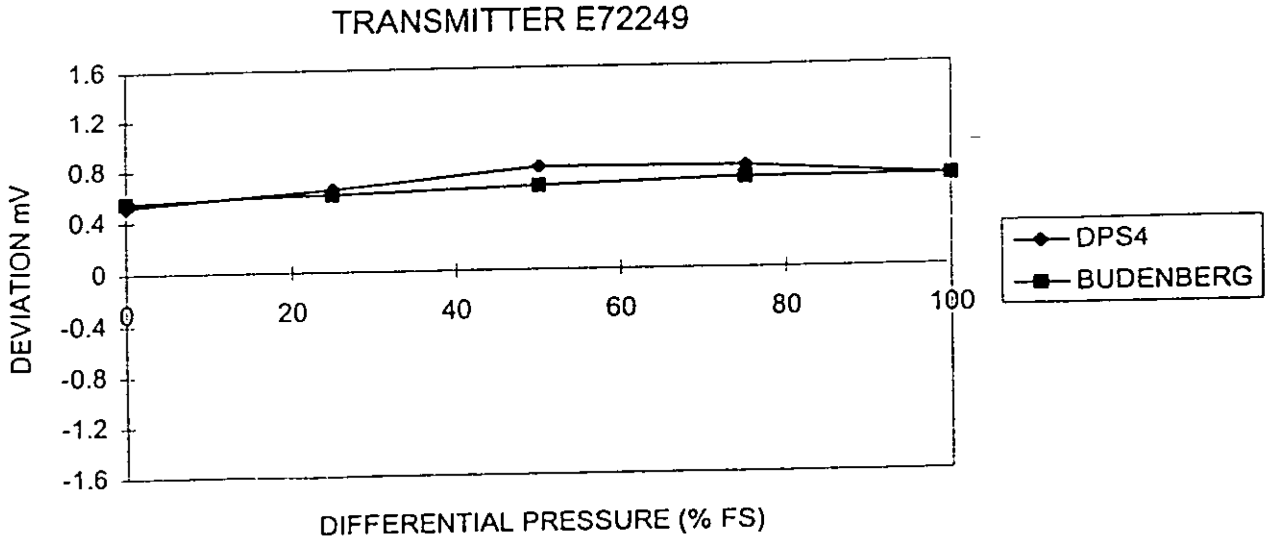
Differential Pressure Ranges	**:**	**0/600, 0/1000 and 0/2000mbar**
Static Pressure	**:**	**0 to 200bar**
Static Pressure Effect	**:**	**±0.0002 % reading/bar**
Reference Accuracy	**:**	**±0.3mbar**
Stability (12 months)	**:**	**±0.06 % reading**
Vibration Effect	**:**	**< ±0.03mbar**

The user-friendly Calibration Software package enables an operator to carry out a precision calibration in a matter of minutes, in-situ and with the minimum of training. The Calibration Software uses a simple graphical interface to control the instrument, implemented as a series of screens, each screen being dedicated to a particular function. The software may be controlled via a keyboard, via a mouse or trackerball, or any combination of the two.

Field trials were carried out at the Shell UK Exploration and Production gas terminal, Bacton, Norfolk, to demonstrate the performance of the DPS4 System when calibrating differential pressure transmitters used for gas flow metering. In order for it to gain acceptance, the DPS4 System must be capable of performing to a level equivalent to the current method, a twin post deadweight tester.

The medium and high range transmitters on the Phase One Fiscal Metering Stream were calibrated using the DPS4 System during the test period. The results obtained from each transmitter were compared with the previous calibration certificate using their Budenberg twin post deadweight tester, which is the current terminal calibration standard. Two transmitters were also calibrated immediately after a DPS4 calibration, using the deadweight tester, the results of which are shown below:-



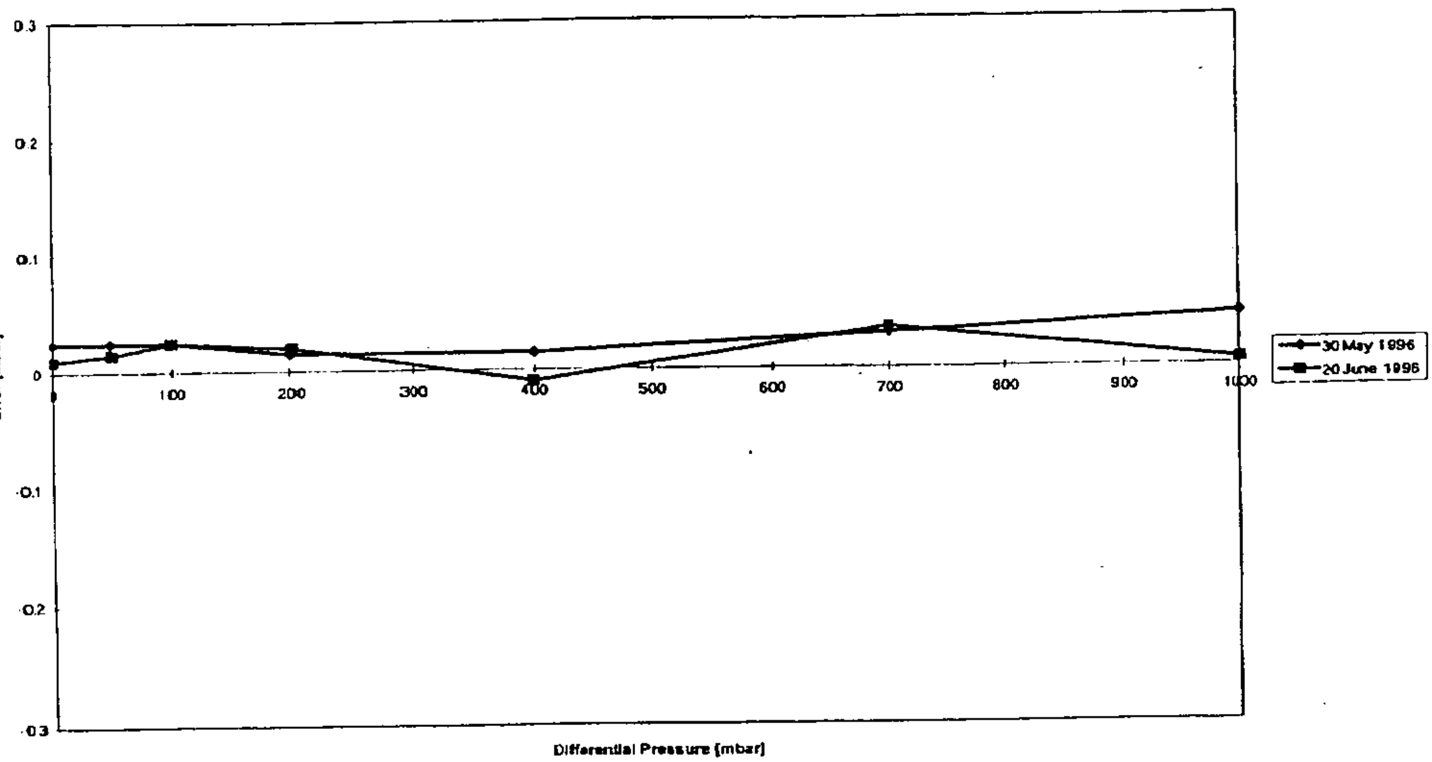


The results obtained during the trials confirmed that the performance of the DPS4 System is comparable with that of a twin post deadweight tester. The DPS4 calibration curves showed the same form as those generated some months earlier using the Budenberg twin post deadweight tester.

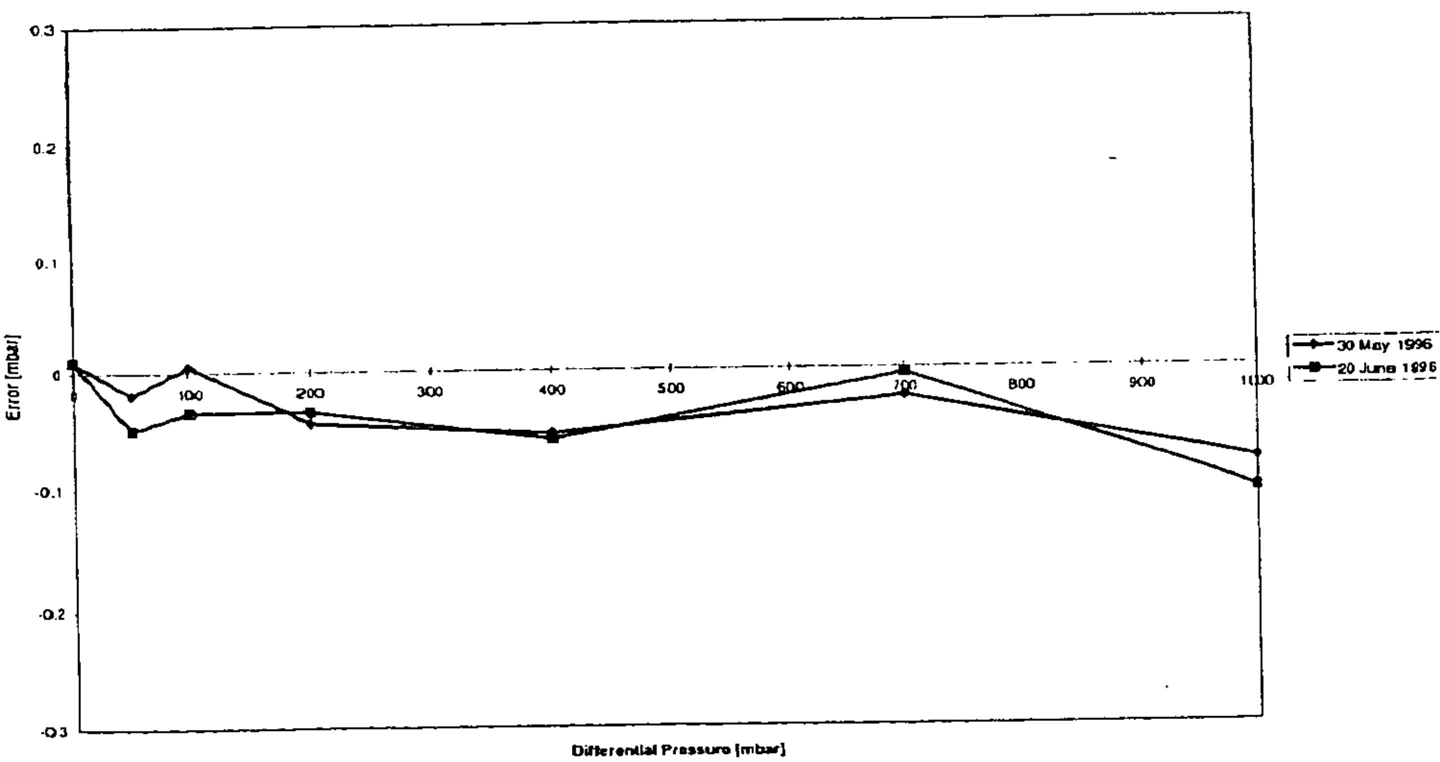
Back-to-back testing of the DPS4 with the Budenberg generated calibration curves of the same form and physical location, deviation between the two methods of less than 0.175mV (0.02% error) were apparent.

The DPS4 was calibrated by SIRA before and after the trials and the results obtained at 0 and 140bar line pressure are shown below:

DPS4 S/N 250 calibration data at atmospheric
(Calibrated by ST&C)



DPS4 S/N 250 calibration data at line pressure of 140 bar
(Calibrated by ST&C)



This product allows oil companies to confidently carry out calibrations on the platforms, hence eliminating current footprinting methods and providing in-situ calibrations at regular intervals thereby reducing transmitter down time and shipping costs.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.